

P. S. I find an observation of mine of the lunar eclipse of May 7th, 1762, printed in the Philosophical Transactions Vol. LII. pag. 543. How it got there I know not, never having thought it worthy the notice of the Royal Society. Besides, in the three observations there said to be made at Mr. Short's before the eclipse, the equation (I suppose by my own mistake) is *subtracted*, which should have been *added* to give the apparent time; and the three apparent times there set down, are to be increased each by  $4' 16''$  to make them the true ones. J. B.

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XIX. *Observations on the Eclipse of the Sun, April 1, 1764: In a Letter to the Rev. Thomas Birch, D. D. Secret. R. S. from Mr. James Ferguson, F. R. S.*

Reverend Sir,

Liverpool, April 2, 1764.

Read April 5, 1764. **H**A VING been at this place ever since the beginning of March, and hoping that the sky would prove favourable (as to my great joy it did) for observing both the lunar eclipse of March 17th, and the solar eclipse of yesterday, I proposed to captain Hutchinson, at whose house I stay, to have a meridian line drawn on the leads on the top of his house, in order to adjust his clock for observing the times of these eclipses by: and we got Mr. Holden, who is master of a mathematical school here, to do it for us, by several observations of the altitude

altitude and azimuth of the Sun by day, and of the stars by night; and there were such exact agreements found by many repeated observations, that no doubt could remain of the meridian's being very well ascertained. The same gentleman, who is justly esteemed to be a very accurate observer, and an able calculator, finds the latitude of Liverpool to be  $53^{\circ} 22'$ ; and its longitude is generally thought to be three degrees west of Greenwich, but he believes it to be somewhat less.

The clock being duly adjusted by our meridian line, at noon, and the time being found by observations of several stars in the evening of March 17, the apparent time of the beginning of the Moon's eclipse was observed to be at  $10^{\text{h}} 27'$  p. m. and the end at  $13^{\text{h}} 11'$ .

On the next day, I calculated the time of the ecliptic conjunction of the Sun and Moon for April 1, by Meyer's tables, as we have them published by Mr. Maskelyne, and then made a projection of the Sun's eclipse for that time by them, for this place, according to it's latitude as determined by Mr. Holden, and supposing it's longitude to be 3 degrees west from Greenwich; and put up this projection in the council-room, that it might be seen, in order to find how it might agree with observation.

Being provided with a good reflecting telescope at captain Hutchinson's, I cut a round hole in a paste-board which would go tight on the tube, and took the Sun's image on a paper behind it, as large as I could have the image of the Sun sharp and well defined around the edge, which was included in a circle of 4 inches diameter. I divided the diameter into 12 equal parts, for digits, and each digit into 4 parts, the

the half of every fourth part being left to be estimated by the eye.

Mr. Holden and two other gentlemen, who are esteemed good observers, and were provided with refracting telescopes and Hadley's quadrants, were with me on Sunday morning, and I desired a third gentleman to note down the times, and to be careful not to mistake the minutes of time; as one might be more apt perhaps to mistake the minutes than the seconds. The clouds threatened us disappointment till about ten minutes before the calculated time of the beginning of the eclipse, and then the Sun shone out very clear; and during the time of observation we were but seldom interrupted by thin flying clouds. The first and last contacts of the Moon and Sun were so sharp and instantaneous, that it seemed possible to determine them within one second of time. Several altitudes of the Sun were taken during the eclipse, by reflecting the Sun's image from a basin of treacle; and the quantities eclipsed were plainly visible on the fore-mentioned image of the Sun on the paper, even to the eighth part of a digit. But the altitudes want yet to be corrected by their respective refractions.

Several people came into the room to see the eclipse, some of whom were subscribers to my lectures; and I could not well refuse them admittance. But I told them before-hand that they must neither speak nor move till the eclipse was found to be begun. This they strictly complied with, and gave no manner of disturbance; and, after it was begun, I desired them all separately to come and view it by the telescope, which hindered me from observing the number of digits eclipsed for the first hour.

I kept

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I kept by the reflecting telescope, and watched the Sun carefully for about five minutes before the calculated time of the beginning of the eclipse. Our watches were adjusted to the mean or equal time; and two of them kept exactly alike during the whole time of the eclipse. The observations were as follows:

	Digits.	Sun's altitude.
8 59	"	eclipse begun $28^{\circ} 37' 00''$ .
10 2	0 —	$8\frac{1}{2}$
10 5	0 —	$9 - 35^{\circ} 49' 30''$
10 11	0 —	$9\frac{3}{4}$
10 13	0 —	$10 - 36^{\circ} 29' 0$
10 18	0 —	$10\frac{3}{8}$
10 21	0 —	$10\frac{1}{2} - 37^{\circ} 0$ uncertain.
10 25	0 —	$10\frac{1}{2} - 37^{\circ} 20' 0$
10 30	0 —	10
10 38	0 —	9
10 40	30	Cusps perpendicular, by a plumb-line's shadow on the Sun's image. Sun's altitude then $38^{\circ} 48' 0''$ .
10 43	30 —	$8\frac{1}{2} - 38^{\circ} 57' 30''$
10 47	0 —	$8 - 39^{\circ} 8' 30''$
10 54	30 —	7
11 0	0 —	$6\frac{1}{2}$
11 3	45 —	6
11 12	0 —	5
11 15	45 —	$4\frac{1}{2}$
11 19	15 —	4
11 28	0 —	3 {uncertain, on account of a thin flying cloud.
11 35	2 —	2
11 45	15 —	$0\frac{1}{2}$ uncertain by another cloud.
11 50	45 —	eclipse ended, the sky quite clear. Sun's altitude $41^{\circ} 27' 0''$ .

All wrote down by Mr. Baxtonden, who kept a copy thereof.

At night, Mr. Holden returned and examined the clock by the stars, and found the time shewn by the clock to be true.

Between the beginning and the middle of the eclipse, we could plainly perceive inequalities in the Moon's eastern limb on the Sun, by means of the reflecting telescope; and I often observed little tremulous bright specks of the Sun's lowermost edge in the otherwise dark place just before, or west, of the lowermost cusp; but they vanished in an instant, except one which was considerably larger than any of the rest, and was visible for about two seconds of time by estimation: but I was so intent upon observing it, and looking for others, that I forgot to have the time of its appearance marked down. This undoubtedly was owing to a dent or valley in that part of the limb of the Moon, which no hill beyond it took off from the sight. But as the eclipse was drawing toward the end, we could perceive no inequalities of the Moon's western limb on the Sun, nor any such specks in the Sun's edge about either of the cusps.

As the Moon's latitude was north ascending, and the cusps not perpendicular till after the middle of the eclipse, I apprehend that when they were so, the apparent altitudes of the centers of the Sun and Moon were equal. But whether they were then so or not, I leave to better judgements to determine.

I shall now set down the times of the beginning, middle, and ending of the eclipse, as pre-determined by the above-mentioned projection thereof for Liverpool,

verpool, from Meyer's tables, which were the apparent times; and shall reduce the observed equal times to the apparent, by subtracting 3 minutes 48 seconds (which we suppose here was the equation of time) from the equal times as observed by the clock and two watches which kept equally going together.

	Apparent times.	
	By projection.	By observation.
	$\text{h } \text{m } \text{s}$	$\text{h } \text{m } \text{s}$
Beginning	— — —	8 56 " 8 55 12 "
Middle	— — —	10 21 45 — not certain:
End	— — —	11 48 " 11 46 57
Duration	— — —	2 52 " 2 51 45
Digits eclipsed	— — —	10 $\frac{2}{3}$ " 10 $\frac{1}{2}$ exactly.

We wish for the accounts of the observed times at the Royal Observatory and at London; because, by comparing the difference, and making allowance for the velocity of the penumbra between Liverpool and London, the longitude of Liverpool might be known.

As the observed quantity was somewhat greater than the projected, as to the digits, and the projection which I gave in, some time ago, to the Royal Society from Meyer's Elements, made the lower edges of the Sun and Moon to be very nearly in contact at the time of greatest observation at Greenwich, I am apt to think that the appearance at Greenwich was annular: and am, with the greatest esteem,

Reverend Sir,

Your most obliged humble servant,

James Ferguson.